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LIST OF THE POLYCYSTID GREGARINES OF THE UNITED STATES.

BY HOWARD CRAWLEY.

I.

The polycystid gregarines of the United States have as yet been but very little studied, and the list here given, which I believe to be complete, contains but twenty-eight species. Of these, six are also found in Europe and were first described from there. It is to Prof. Leidy that we owe the better part of our knowledge of the American forms. Ten species were described by him in accounts published in the *Proceedings* of the Academy and in the *Transactions of the American Philosophical Society* from 1848–1889. In addition to these, four more species are described and figured by Leidy in manuscript notes now in possession of the Academy, access to which I owe to the kindness of the Secretary, Dr. Nolan. Of the remaining eight forms, one was described by Porter, and seven were found by me in animals collected at Wyncote, Pa., and Raleigh, N. C., during the past year.

The four forms described in Leidy's manuscript, and the one by Porter, were not named. I have accordingly created new species for them which, with the seven that I discovered, makes twelve new species. Although the method of naming a gregarine after its host has been objected to by Schneider, it appears to me the most advisable, and it has accordingly been followed. Considerable difficulty was experienced, however, in determining to which genera these new species belong. The generic characters of gregarines are mostly those of the cysts and spores, and I was particularly unfortunate in failing to obtain these stages. In several cases it has been possible to judge, even without these criteria, what the correct genus is, and such forms have been placed where they probably belong without question. Where, however, there was considerable doubt, a question mark has been placed before the generic name.

II.

The following is a list of the Arthropoda found to contain gregarines, the first column giving the number of individuals examined, the second the number parasitized:

<i>Julus</i> and <i>Parajulus</i>	165	158
<i>Polydesmus virginensis</i>	32	26
<i>Fontaria</i> sp.....	2	2
<i>Lysiopetalum lactarium</i>	16	6
<i>Spirobolus</i> sp.....	1	1
<i>Lithobius forcipatus</i>	13	4
<i>Scolopocryptops sexspinosus</i>	6	3
<i>Scutigera forceps</i>	4	3
<i>Geophilus</i> sp.....	8	0
<i>Elater</i> sp.....	8	1
Cucujid larva.....	5	2
<i>Discælus ovalis</i>	2	2
<i>Harpalus caliginosus</i>	1	1
<i>Dytiscus</i> sp., larva.....	1	1

It is headed with *Julus* and *Parajulus*. These two genera of Diplopods are distinguished by characters of the mouth-parts and anterior feet, but they are much alike and the smaller species of *Parajulus* are but little larger than those of *Julus*. No attempt was made to distinguish between these two genera and much less between the various species, but such an attempt would have been of no especial utility, even if successful. They are to be found together, beneath logs, stones and leaves, and, as the list shows, they are almost invariably parasitized, the gregarine being *Stenophora juli*. It is possible to obtain these Diplopods at any season of the year, and so far as my observations go, the gregarines have no seasonal cycle, but all stages are met with at any time. Usually a given host contains a moderate number of gregarines, from twenty to forty, these ranging from the largest adults to the smallest intracellular stages. Frequently, however, only a very few parasites are found in a host, and in such cases they will be for the most part quite small. In none of the millipedes examined have I come across the cysts, nor, to my knowledge, the free spores.

In consideration of their gregarious habit, and their diet of rotten wood and vegetable fibre, it is easy to see why *Julus* and *Parajulus* are so persistently parasitized. It is also worthy of note that other animals having the same mode of life and generally found in the same places do not appear ever to contain gregarines. A case in point is that of the Isopoda, *Oniscus* and *Porcellio*. These are almost always found with *Julus* and *Parajulus*, and they doubtless frequently swallow the spores of *Stenophora*. The isopod intestine is, however, lined with chitin, and

the immunity is probably due to the inability of a gregarine sporozoite to get into the cells.

The 32 specimens of *Polydesmus* examined were some from Wyncote and some from Raleigh, N. C. *Polydesmus* is infected by two gregarines, *Gregarina polydesmivirginiensis* and *Amphoroides fontariæ*. Of these, both were present in 14 hosts, *G. polydesmivirginiensis* alone in five and *A. fontariæ* alone in seven. The Diplopods from one region were about as frequently parasitized as from the other, but *G. polydesmivirginiensis* was present oftener and in larger numbers in the animals from Wyncote than in those from Raleigh, while the reverse was true in the case of *A. fontariæ*. It is for this reason that the latter, although a frequent parasite of *Polydesmus*, has been named for *Fontaria*. Where two gregarines parasitize a given host, it is generally found that one occurs far more frequently than the other. The more frequent parasite is spoken of as the primary, the other as the secondary. Usually, also, the primary parasite of one host is the secondary of another. In Pennsylvania, where *Polydesmus* is common and *Fontaria* does not occur, the former, as stated above, is more often parasitized by *G. polydesmivirginiensis* than by *A. fontariæ*. In North Carolina, where *Fontaria* is common, the more usual parasite of *Polydesmus* is *A. fontariæ*. This gregarine, furthermore, was present in great numbers in the two individuals of *Fontaria* I was able to examine. It may therefore be concluded that *G. polydesmivirginiensis* is the primary of *Polydesmus*, while *A. fontariæ* is the primary of *Fontaria*.

In *Polydesmus*, *G. polydesmivirginiensis* was usually present in moderate numbers, from 20 to 50, although occasionally there were only a very few. On the other hand, *A. fontariæ* ran to extremes. Some millipedes would show only two or three gregarines, while in other cases they were present by the hundreds. There were only a few, however, in the animals taken at Wyncote.

Of sixteen specimens of *Lysiopetalum lactarium*, six were parasitized. Two gregarines occur, one a new species which I have named *Gregarina calverti*, the other apparently *Stenophora juli*. Both gregarines were present in two hosts, *G. calverti* alone in three and *S. juli* alone in one. Thus the former species was present five times and the latter three. *G. calverti* is therefore to be regarded as the primary parasite of *Lysiopetalum*.

This millipede is found under stones in much dryer places than *Julus*, *Parajulus* or *Polydesmus*, and it is somewhat solitary in habit. It is thus easy to see why only a comparatively small percentage of them is parasitized. *G. calverti* occurred in moderate numbers in all

cases, whereas *S. juli* was present in hundreds in one case and in only small numbers in the other two.

Echinomera hispida, the primary parasite of *Lithobius forcipatus*, was found only four times in thirteen hosts collected at Wyncote and Raleigh. In two of these cases, moreover, but a single gregarine was found. At Cambridge, Mass., where *Lithobius* is a much commoner animal, a larger percentage are parasitized and the gregarines are present in larger numbers. *Actinocephalus dujardini*, the secondary parasite of *Lithobius*, is very rare.

Scolopocryptops is parasitized by *Hoplorhynchus actinotus*. The gregarines occur in small numbers, from ten to twelve, in fifty per cent. of the Chilopods.

Of the five specimens of *Scutigera forceps*, four contained gregarines. The species is *Trichorhynchus pulcher*; and never but a very few, from three to ten, are present.

It is not necessary to go over the balance of the list in detail. Attention may, however, be called to the fact that eight individuals of *Geophilus* were opened in vain.

III.

Gregarina blattarum Sieb.

- Gregarina blattarum* Siebold (1839), p. 57, Taf. 3, figs. 57-61.
Gregarina blattarum Frantzius (1848), p. 190, Taf. 7, fig. iii.
Gregarina blattarum Stein (1848), p. 182, Taf. 9, figs. 38, 39.
Gregarina blattæ-orientalis Leidy (1853), p. 239, Pl. 11, figs. 39-41.
Clepsidrina blattarum Schneider (1875), p. 580, Pl. 17, figs. 11, 12.
Clepsidrina blattarum Bütschli (1881), p. 384, Taf. 20, 21.
Clepsidrina blattarum Wolters (1891), p. 115, Taf. 7.
Clepsidrina blattarum Marshall (1893), p. 25, Taf. 20, 21.

Common in *Periplaneta orientalis*, *Periplaneta americana* and *Ectobia* (*Blatta*) *germanica*. A few specimens of *Ischnoptera pennsylvanicus*, the field cockroach, were examined, but none contained gregarines.

?Gregarina termitis Leidy.

- Gregarina termitis* Leidy (1881), p. 441, fig. 27.
Gregarina termitis Porter (1897), p. 65, Pl. 6, figs. 73-76.

Leidy says: "A small gregarine was once noticed in our Termite, and is represented in fig. 27. The body is ovoid, with the narrower end posterior. The head [protomerite] spheroid, compressed from above downward. Length .06 mm.; head .018 mm. long, .03 broad; body .036 mm. broad."

Porter adds the information that the gregarines are very common in some specimens of termites, occurring mostly in the anterior part of the small intestine, and that the nucleus contains one karyosome.

I have opened perhaps a dozen termites in a search for this parasite, but have not yet encountered it.

Gregarina achetæabbreviatæ Leidy. Pl. III, figs. 34-35.

Gregarina achetæabbreviatæ Leidy (1853), p. 238, Pl. 11, figs 33, 34.

Epimerite: Simple, spherical.

Protomerite: Somewhat pentagonal to hemispherical. Separated from the deutomerite by a sharp constriction. Shape modified in the associations.

Deutomerite: Cylindrical, tapering slightly. Terminating bluntly.

Epicyte: Thick.

Sarcocyte: ?.

Entocyte: Of equal density in both protomerite and deutomerite.

Nucleus: Large, spherical with several karyosomes.

Dimensions: Maximum length 600 microns.

Host: *Acheta abbreviata*. Infection extensive.

Locality: Beach Haven, N. J.

? **Gregarina scarabeirelictæ** Leidy.

Gregarina scarabeirelictæ Leidy (1851), p. 208, 287.

Gregarina scarabeirelictæ Leidy (1856), p. 47.

I have not seen this species.

? **Gregarina melolonthæbrunnæ** Leidy.

Gregarina melolonthæbrunnæ Leidy (1856), p. 47.

I have not seen this species.

Gregarina passalicornuti Leidy. Pl. II, fig. 24.

Gregarina passalicornuti Leidy (1853), p. 238, Pl. 11, figs. 30-31.

Epimerite: ?.

Protomerite: Hemispherical in the primitives; considerably compressed in the satellites.

Deutomerite: Cylindrical; sometimes slightly narrower about the middle.

Epicyte: Thick.

Sarcocyte: Thick.

Entocyte: Opaque.

Nucleus: Moderate. Spherical.

Dimensions: Average length of pairs 350-400 microns.

Host: *Passalus cornutus*.

? **Gregarina polydesmivirginiensis** Leidy. Pl. II, fig. 25.

Gregarina polydesmivirginiensis Leidy (1853), p. 238, Pl. 10, figs. 23-29.

Epimerite: Not seen.

Protomerite: Always small; sometimes apparently undeveloped in

the younger animals. Never any constriction between it and the deutomerite in relaxed animals.

Deutomerite: Long. Anterior half usually much broader than posterior half. Usually considerably curved.

Epicyte: Very distinct. $1\frac{1}{2}$ -2 microns thick.

Sarcocyte: Distinct.

Entocyte: Usually, but not always, considerably denser in the anterior part of the deutomerite than in the posterior part.

Nucleus: Always with one karyosome.

Dimensions: 400 microns long.

Movements: This is a very active gregarine, and displays continually both changes of shape and progression. The contractions are generally confined to the anterior part of the deutomerite. As a rule, the smaller animals are less active than the larger.

Host: *Polydesmus virginianensis*. Infection is common, the parasites being present in moderate numbers.

Locality: Wyncote, Pa., and Raleigh, N. C.

? *Gregarina elateræ* sp. n. Pl. I, fig. 11.

Epimerite: Spherical, with a granular contents. Usual size and appearance shown by fig. 11. In several cases, however, apparently on account of the absorption of water, it had increased enormously in size, so that its diameter exceeded the length of the gregarine.

Protomerite: Elliptical in outline, with the greater axis transverse. Posterior limit straight. Separated from the deutomerite by a sharp constriction.

Deutomerite: Oval to subspherical.

Epicyte: Very thin.

Sarcocyte: ?.

Entocyte: Granular in all three segments. Sparsely filled with large and very distinct granules, so that the appearance presented was rather that of a ciliate or a heliozoan packed with plant spores than a gregarine.

Nucleus: Not seen.

Dimensions: Maximum length 62 microns.

Movements: The animals were very sluggish, the only movements seen being an occasional lateral displacement of the protomerite, and, in one case, progression of perhaps one-half the animal's length.

Host: The larva of a large species of *Elater*. Infection only occasional, and never but a few gregarines present.

Locality: Wyncote, Pa.

?*Gregarina discæli* sp. n. Pl. I, figs. 7-10.

Epimerite: ?.

Protomerite: Helmet-shaped to pentagonal. Separated from the deutomerite by a shallow constriction in the adults, by a deep constriction in the young.

Deutomerite: Greatly elongated, cylindrical to slightly conical, terminating bluntly.

Epicyle: Very thin. Longitudinal striations not evident.

Sarcocyte: Apparently wanting.

Endocyte: Densely granular and opaque in the deutomerite; nearly transparent in the protomerite. Anterior part of protomerite free from granules.

Nucleus: Not readily seen, but apparently possessed of a number of karyosomes disposed in a cluster.

Dimensions: Maximum length 1200 microns. In the young the ratio of length to breadth is about eight to one, in the adults about fifteen to one.

Movements: These gregarines possess the flexibility of an eel. They frequently bent themselves into crescents, circles and short, close spirals, this last phenomenon demonstrating the spirality of the myocyte. Fig. 10 shows the longitudinal axis of one contorted animal observed, A being the anterior and P the posterior end.

Host: *Discalus ovalis*. Of the two beetles examined, one contained from 50-75 parasites; the other not nearly so many.

Locality: Wyncote, Pa.

No cases of association were seen, but for the most part these gregarines were disposed in dense bunches with their posterior ends glued together. There was one such mass seen which presented the appearance of a bunch of celery, the animals being all closely apposed from their posterior ends nearly as far forward as their protomerites.

?*Gregarina xylopinii* sp. n.¹ Pl. III, figs. 29, 30.

The two gregarines shown in figs. 29 and 30 are stated by Leidy to be parasites of the beetle *Xylopinus saperdoides*. Of the six beetles examined, five contained gregarines of the form shown in fig. 29, one of the form shown in fig. 30. These two forms are so dissimilar that it appears better, at present, to give only the figures, reserving the description until additional information is at hand.

?*Gregarina boletophagi* sp. n.² Pl. II, figs. 26-28.

Epimerite: ?.

Protomerite: Large, variable in shape. Separated from deutomerite by a sharp constriction.

¹ From Leidy's MSS.

² From Leidy's MSS.

Deutomerite: Cylindrical, with a protrusion at the posterior end, to conical with a pointed end.

Epicyte: Thick.

Sarcocyte: ?.

Entocyte: Dense, uniform in both protomerite and deutomerite.

Nucleus: Moderate; oval to spherical, with one karyosome.

Dimensions: 320 microns long.

Host: *Boletophagus cornutus*.

Locality: Swarthmore, Pa.

? *Gregarina calverti*³ sp. n. Pl. II, figs. 19-21.

Epimerite: Not seen.

Protomerite: Greatly compressed in the large animals (figs. 19, 20). Anterior boundary usually straight or slightly convex, but frequently concave, giving the protomerite the form of a shallow cup. Approximately reniform in the young animals (fig. 21). Constriction always deep and sharp.

Deutomerite: Displays a shoulder at the anterior end, being here widest. Narrows gradually backward, more regularly in the younger, less regularly in the older animals. Posterior end always blunt.

Epicyte: Thicker than the sarcocyte. Longitudinal sculpturing may or may not be present. It was often possible to see that the protomerite was longitudinally striated, but the cause for this appearance seemed to lie deeper than the epicyte.

Sarcocyte: Thinner than the epicyte.

Myocyte: Easily seen in the living animals.

Entocyte: In large animals black in transmitted light in the deutomerite and nearly so in the protomerite. In most cases, however, the granules do not fill the entire entocyte, but thin out rapidly toward the posterior end, so that in the last fourth or fifth of the entocyte they constitute only a narrow, central strip. This condition is shown in fig. 21, from a young animal, and is held true for nearly all the gregarines seen.

Nucleus: Not large, spherical, with one spherical karyosome.

Movements: These gregarines, although quite flexible, are rather sluggish, and usually lie motionless. Progression, when observed, was generally accompanied by lateral movements of the protomerite. As a rule, the animals were slightly curved, a phenomenon frequently displayed by elongated gregarines.

Dimensions: Maximum length 1,500 microns.

Host: *Lysiopetalum lactarium*.

Locality: Wyncote, Pa.

³ To Philip P. Calvert.

? *Gregarina harpali* sp. n. Pl. I, figs. 1-4.

Epimerite: Not seen.

Protomerite: In the adults (fig. 1) hemispherical and narrower than the deutomerite, from which it is separated by a sharp, but not extensive, constriction. In the young (figs. 2 and 3) knob-shaped, wider than the deutomerite and separated from that part by a shallow constriction.

Deutomerite: Conical in the adults to cylindrical in the young. The posterior end is normally blunt and rounded. These gregarines, however, are quite polymorphic and readily change shape.

Epicyte: Relatively very thin in the adults. Marked with very fine longitudinal ridges, which are not visible in the living animals and require sections for their demonstration.

Sarcocyte: Not visible in adults. In the young (fig. 3) present in the protomerite and constituting the thick septum. Apparently wanting in the rest of the deutomerite. In the front part of the protomerite a little papilla is present, apparently composed of a differentiation of the sarcocyte. This papilla is much more evident in some specimens than in others, and sometimes takes the form of a minute knob. It was never seen in adult animals.

Entocyte: Black in transmitted light in the adults, semi-transparent in the young, but in both as dense in the protomerite as in the deutomerite. In the young, as shown in fig. 3, there is a crescentic area almost free from granules. In stained and sectioned animals (fig. 4) this crescentic area is seen to consist of very dense cytoplasm, with a considerable affinity for stains. This condition is wholly lost in the adults.

Nucleus: In the living animals, wholly invisible in the adults and not satisfactorily to be made out in the young. Sectioned material shows that it is large, spherical, and possesses several karyosomes. These are variable in size and are scattered singly throughout the entire extent of the nucleus. They display the usual phenomenon of vacuoles.

Movements: The movements displayed by these gregarines were leisurely muscular contractions and slow progression. There was also a disposition to rumple the edges of the body, so that the epicyte of the deutomerite presented a series of scallops. These scallops underwent slow changes, the movement being doubtless the usual peristalsis, although very much slower than in the case of most gregarines. Progression was in either more or less of a straight line, or in curves of short radius. In the latter case, the animals held their bodies so bent that the longitudinal axis formed a curve. In all cases progression was

extremely slow. A number of animals showed no movement whatever and some of these held the scalloped outline without change.

Dimensions: Length 225–700 microns.

Host: *Harpalus caliginosus*. The gregarines were present in the intestine of the one beetle examined in hundreds, and while no associations were seen, there was a very marked tendency for them to be lying massed closely together.

Locality: Wyncote, Pa.

?*Hirmocystis ovalis* sp. n. Pl. I, figs. 5–6.

Epimerite: Usually elliptical in outline, with the longer axis transverse, but frequently considerably flattened down. Wall with double contour. Contents hyaline.

Protomerite: Hemispherical.

Deutomerite: Cylindrical to oval, but more usually the latter. Always terminating bluntly.

Epicyte: Thin over the anterior part of the protomerite; elsewhere thick. Longitudinal striations not seen.

Sarcocyte: ?.

Entocyte: Dark brown in the larger individuals, and of approximately the same density in both protomerite and deutomerite. The anterior third of the protomerite is usually, but not always, free from granules.

Nucleus: Not seen.

Dimensions: Greatest length 70 microns.

Host: The larva of a beetle doubtfully identified as belonging to the Cucujidæ. The gregarines occurred sparingly, ten or twelve being the greatest number found in any one host. About half the insects examined were parasitized.

?*Euspora lucani* sp. n.⁴ Pl. III, fig. 38.

Epimerite: ?.

Protomerite: Small, compressed from before backward. Separated from the deutomerite by a deep constriction.

Deutomerite: Cylindrical; sometimes narrower in the middle.

Epicyte: Thick.

Sarcocyte: ?.

Entocyte: ?.

Nucleus: ?.

Dimensions: Of one association; primite 520×128 microns, satellite 360×108 microns.

⁴ From Leidy's MSS.

Host: Lucanus dama.

Locality: Swarthmore, Pa.

The gregarines occurred either singly or associated in pairs.

***Stenophora juli* Frantzius.**

Gregarina juli Frantzius (1848), p. 194, Taf. 7, fig. x, 1-2.

Gregarina larvata Leidy (1848-49), p. 232.

Gregarina juli-marginati Leidy (1853), p. 237, Pl. 10, figs. 1-20.

Gregarina juli-pusulli Leidy (1853), p. 238, Pl. 10, figs. 21-22.

Stenocephalus juli Schneider (1875), p. 584, Pl. 20, figs. 29-33.

The best figures extant of this gregarine are those published by Leidy in 1853. His fig. 17 is especially good in showing the apparent orifice through the thickened epicyte of the anterior part of the protomerite. The contortions displayed by the gregarine are also portrayed in an admirable manner.

This species lives in the intestine of *Julus* and the smaller species of *Parajulus*. It is extremely common, occurring in at least 90 per cent. of the hosts examined, usually in moderate numbers, from forty to fifty or thereabouts, but frequently only a very few are present. All stages from the smallest intracellular forms to the largest sporonts, may be found at any season of the year, but cysts are very rarely seen.

Stenophora juli continues as a cell parasite until it has reached a length of perhaps 100 microns. The cephalont stage is probably omitted. Leidy gives the maximum size as one-thirtieth of an inch, which is nearly a millimeter, but I have never seen the species longer than 400 microns.

***Stenophora spiroboli* sp. n. Pl. II, fig. 22.**

Epimerite: Not seen.

Protomerite: Very small, narrower than the deutomerite and much compressed from before backward.

Deutomerite: Cylindrical, tapering but very little and terminating bluntly.

Epicyte: Very distinct; about $1\frac{1}{2}$ microns thick. Longitudinal striations easily seen.

Sarcocyte: Well developed; about 2 microns thick over most of the animal, but attaining twice this thickness at the posterior end.

Entocyte: Opaque in both protomerite and deutomerite.

Nucleus: Not seen.

Dimensions: Maximum length 1,000 microns.

Movements: While progression was slight, the animals showed constant muscular movements. In some cases they bent themselves into the shape of the letter U, in others merely the anterior end was bent

over, but the one condition passed into the other. In addition, the anterior end was constantly being wrinkled and distorted, and little pseudopodia-like processes were protruded and withdrawn.

Host: Spirobolus. But one individual examined, which contained seven or eight gregarines, none less than 500 microns in length.

Locality: Raleigh, N. C.

***Echinomera hispida* Aimé Schn.**

Echinocephalus hispidus Schneider (1875), p. 593, Pl. 16, figs. 36–40.

This gregarine was found in four out of thirteen individuals of *Lithobius forcipatus* collected at Wyncote, Pa., and Raleigh, N. C., but it is much commoner at Cambridge, Mass.

***Echinomera microcephala* Leidy.**

Gregarina microcephala Leidy (1889), p. 11, 1 fig.

Our knowledge of this form rests upon a very short description given by Prof. Leidy. It is very much like *Echinomera hispida*, and is accordingly placed in that genus, but retained as a distinct species.

The total length is 350 microns; greatest width 100 microns. The protomerite is 12 microns long by 40 microns wide.

Host: Hoplocephala bicornis.

***Trichorhynchus pulcher* Aimé Schn.**

Trichorhynchus pulcher Schneider (1882), p. 438, Pl. 13, fig. 14.

Gregarina megacephala Leidy (1889), p. 11, 1 fig.

This form is well described by Aimé Schneider, whose figure also is excellent, giving a very accurate idea of the actual animal. Schneider, however, gives no dimensions, while Leidy says that the dimensions vary from 420–750 microns, these figures agreeing very closely with those which I obtained.

My own observations on this species show it to be an active, very polymorphic gregarine, with the ability to undergo extensive alterations in shape. Thus, the anterior end of the protomerite, normally a blunt curve, frequently protrudes in a long tongue-shaped process. The peristaltic movement, so frequently displayed by gregarines, may, in this species, pass forward as well as backward. This indicates that here the contractile elements are capable of operating as well in one direction as another, which is certainly not the case in most polycystid gregarines.

Fusion, preparatory to encystment, was seen to take place “head to head.”

Amphoroides fontariae sp. n. Pl. I, figs. 12-14.

Epimerite: Not seen.

Protomerite: More or less pentagonal in outline. Separated from deutomerite by an evident constriction.

Deutomerite: Variable, normally a long oval. Sometimes shows a distinct shoulder in front. Always terminates bluntly.

Epicyte: Very distinct over the entire animal. Greatly thickened at the anterior part of the protomerite, this feature being as well marked in the smallest as in the largest animals. Longitudinal striations not evident.

Sarcocyte: Always present, but much more evident in some animals than in others.

Entocyte: Very opaque in the deutomerite, and nearly transparent in the protomerite, the contrast between the two parts being very sharp in this gregarine.

Nucleus: Moderate in size, spherical, with one usually spherical karyosome. Not always evident in the living animals.

Dimensions: Maximum length 135 microns.

Movements: This gregarine is very active, displaying constantly both muscular contractions and a gliding progression. The muscular activity manifests itself in lateral displacements of the protomerite, in bendings of the deutomerite and in a peristalsis which involves the anterior part of the deutomerite. Progression is easy and rapid and always accompanied by evidences of muscular contraction.

Hosts: *Polydesmus* and *Fontaria*, Diplopods of the family Polydesmidae. The gregarines were usually present in hundreds in the parasitized animal, but often only a very few could be found.

Localities: Wyncote, Pa., and Raleigh, N. C.

Asterophora philica Leidy. Pl. III, figs. 31-33.

Gregarina philica Leidy (1889), p. 9, 1 fig.

It is impossible to give a description of this species. Figs. 31 and 32 are very plainly of the same gregarine, whereas fig. 33 seems almost certainly to belong to a different species. Further, the form figured by Leidy in 1889 is not so closely like that shown by figs. 31 and 32 as to render it certain that the two are the same.

I therefore include the three different forms under the same name, giving only the figures and reference, until such time as sufficient material is obtained to determine accurately what the actual facts may be.

The gregarines figured were about 300 microns long.

Asterophora cratoparis sp. n.⁵ Pl. II, fig. 23.

Epimerite: Small; consists of a number of ribs projecting from a central knob.

Protomerite: Nearly reniform, but with a conical projection in front, upon which rests the epimerite. Separated from the deutomerite by a sharp constriction.

Deutomerite: Lanceolate; terminating bluntly.

Epicyte: Thick.

Sarcocyte: ?.

Entocyte: ?.

Nucleus: Not small; spherical, with a spherical karyosome.

Dimensions: Length 540 microns.

Host: *Cratoparis lunatus*, a beetle of the family Curculionidæ. Eight gregarines, all attached to the wall of the host's intestine, were present in the one individual examined.

Locality: Swarthmore, Pa.

Stephanophora locustæcarolinæ Leidy.

Gregarina locustæcarolinæ Leidy (1853), p. 239, Pl. 11, figs. 35-38.

Provisionally placed in the genus *Stephanophora* on account of the character of the epimerite. I have not yet encountered the species.

Bothriopsis histrio Aimé Schn. Pl. II, figs. 15-18.

Bothriopsis histrio Schneider (1875), p. 596, Pl. 21, figs. 8-13.

Bothriopsis histrio Léger (1892), p. 136, Pl. 13, figs. 1-3.

This gregarine was described by Aimé Schneider in 1875. The diagnosis then given is as follows: Epimerite wanting. Protomerite forming a large rounded mass, of which the anterior part may be either very convex or quite concave. Deutomerite oval. Septum projecting forward in such a fashion that it resembles the finger of a glove. Nucleus elliptical in outline, with several karyosomes. Epicyte with double contour, sarcocyte wanting and entocyte very finely granular. Animal highly polymorphic and movements very rapid.

Hosts: *Hydaticus cinereus* (larva), *Colymbetes fuscus* and *Acilius sulcatus*.

Léger adds the information that the epimerite consists of a number of long filaments.

I find what is apparently the same gregarine in the larva of *Dytiscus* sp., but four or five imagines were opened in vain. My observations, however, differ somewhat from Schneider's, although they do not appear to warrant creating a new species.

Fig. 15 shows the protomerite of this gregarine. As stated by Schnei-

⁵ From Leidy's MSS.

der, it is a large rounded mass; but whereas Schneider's figures represent it to be solid, I find that it contains, at least in some cases, a large cavity. Within this cavity was a fluid in which floated a few granules.

This condition was the more usual, and free gregarines, as they moved about on the slide, presented a remarkable appearance with their enormous balloon-shaped protomerites. The appearance of other individuals was, however, markedly different. Fig. 17 shows an attached animal. Here the protomerite was narrow and elongated, the narrow anterior end being, so far as I was able to see, embedded in the cells of the host. In this case there were no indications of a cavity within the protomerite.

It is to be observed, in figs. 15, 17 and 18, that the septum dips backward. In a number of cases, however, the septum dipped forward, and such appears to have been the only condition seen by Schneider. In these gregarines, accordingly, the septum may dip in either direction, which indicates a high degree of flexibility and elasticity on the part of the sarcocyte, and this condition is also suggested by their superlative polymorphism.

It is therefore possible to interpret the rather curious appearance shown in fig. 16. This was drawn from a progressing individual, to all appearances wholly normal. In this animal, the protomerite lies embedded within the deutomerite. It may be suggested that this is derived from the condition shown in fig. 18 by a mere contraction of the most anterior part of the deutomerite, by which the protomerite is forced backward. Quite a number of animals presented this appearance.

Fig. 18 is from a permanent mount, and probably represents the normal form of the protomerite when only a small quantity of fluid is present. It is noteworthy in that the protomerite is more densely granular than the deutomerite.

The larger, more elongated specimens reached a length of 425 microns. There were about 25 gregarines in the beetle-larva, which was taken at Wyncote, Pa.

Actinocephalus dujardini Aimé Schn.

Actinocephalus dujardini Schneider (1875), p. 589, Pl. 16, figs. 9-20.

I have seen this little gregarine several times in specimens of *Lithobius forcipatus*.

Hoplorhynchus actinotus Leidy. Pl. III, figs. 36, 37.

Gregarina actinotus Leidy (1889), p. 10, 1 fig.

Epimerite: Amphora-shaped. Differentiated in front into four

dichotomously branched lobes. Contents hyaline. Easily detached. In the small animals, making up nearly one-half the total length; in the adults, from one-fourth to one-fifth of the total length.

Protomerite: In the young, knob-shaped, with the transverse and longitudinal diameters about equal. In the adults, hemispherical, with the transverse diameter twice as great as the longitudinal.

Deutomerite: Conical, with a pointed posterior end. Usually a shoulder at the septum. Subject to considerable alterations in shape, being at one time longer and narrower, at another shorter and broader.

Epicyte: About 3 microns thick [in the larger individuals. Longitudinal striations could not be made out.

Sarcocyte: ?.

Entocyte: Absolutely opaque in the larger animals. Much more nearly transparent in the smaller.

Nucleus: Only apparent as a light oval area, usually lying diagonally across the deutomerite.

Dimensions: The largest sporont seen was 485 microns long by 105 microns broad. Leidy gives 600 microns for the length of a cephalont.

Host: *Scolopocryptops*. Not rare. Infection usually moderate, from 15-30 parasites per host.

Locality: Wyncote, Pa., Raleigh, N. C., and Wallingford, Pa.

Apparently, in this gregarine, the septum tends to disappear. It is much more evident in some cephalonts than in others, and in one sporont seen no septum could be made out, and the entocyte of the protomerite was not distinguishable from that of the deutomerite.

***Doliocystis rhyncobli* sp. n.**

—— — Porter (1897a), p. 8, Pl. 3, figs. 37-53.

This form is described, but not named, by Porter, and the figures given are scarcely diagnostic enough to determine the correct genus. Its habitat, the intestine of the marine worm *Rhyncobolus americanus* Verrill, renders it probable, however, that the parasite belongs to the genus *Doliocystis*, and the specific name *rhyncoboli* may appropriately be used.

Porter describes it as a tricytid, but says: "The conical base of the epimerite is continuous with the contents of the anterior portion of the protomerite, for there is an orifice through the cuticular wall of the protomerite, and the base of the epimerite is composed of protoplasm very similar to that of the protomerite."

But such an intimate union between the protoplasmic parts of protomerite and epimerite is not known to exist in gregarines. It may therefore be suggested that that part of the animal which Porter took to

be protomerite plus epimerite was in reality only the epimerite, and that the gregarine is truly a dicystid.

The deutomerite is described as being composed of very loose and highly vacuolated protoplasm, and the nucleus as showing several karyosomes. The animal is 700 microns long.

The host is *Rhyncobolus americanus* Verrill. The parasite occurs in one worm in ten, and rarely more than eight were found in any one host.

Porter makes the suggestion that gregarine locomotion "is probably caused by a very slight undulatory motion of the under side of the animal." I regret having been unaware of this suggestion, which accords with my own opinions, at the time I wrote my article on gregarine progression.

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EXPLANATION OF PLATES I, II AND III.

PLATE I, Fig. 1.—*Gregarina harpali* (p. 49). Adult.

Fig. 2.—*Gregarina harpali* (p. 49). Young.

Fig. 3.—*Gregarina harpali* (p. 49). Protomerite of a young animal.

Fig. 4.—*Gregarina harpali* (p. 49). Section of the protomerite of a young animal.

Fig. 5.—*Hirmocystis ovalis* (p. 50). Sporont.

Fig. 6.—*Hirmocystis ovalis* (p. 50). Cephalont.

Fig. 7.—*Gregarina discæli* (p. 47). Adult.

Fig. 8.—*Gregarina discæli* (p. 47). Young.

Fig. 9.—*Gregarina discæli* (p. 47). Protomerite of an adult animal.

Fig. 10.—*Gregarina discæli* (p. 47). Diagram showing the longitudinal axis of a contorted animal, A being the anterior and P the posterior end.

Fig. 11.—*Gregarina elateræ* (p. 46). Cephalont.

Figs. 12-14.—*Amphoroides fontariæ* (p. 53). Adults.

PLATE II, Figs. 15-18.—*Bothriopsis histrio* (p. 54).

Fig. 19.—*Gregarina calverti* (p. 48). Adult.

Fig. 20.—*Gregarina calverti* (p. 48). Protomerite of an adult.

Fig. 21.—*Gregarina calverti* (p. 48). Young.

Fig. 22.—*Stenophora spiroboli* (p. 51). Adult.

Fig. 23.—*Asterophora cratoparis* (p. 54). Cephalont. (Copied from Leidy's MSS.)

Fig. 24.—*Gregarina passalicornuti* (p. 45). Association. (Copied from Leidy's MSS.)

Fig. 25.—*Gregarina polydesmivirginiensis* (p. 45). Adult. (Copied from Leidy's MSS.)

Figs. 26-28.—*Gregarina boletophagi* (p. 47). (Copied from Leidy's MSS.)

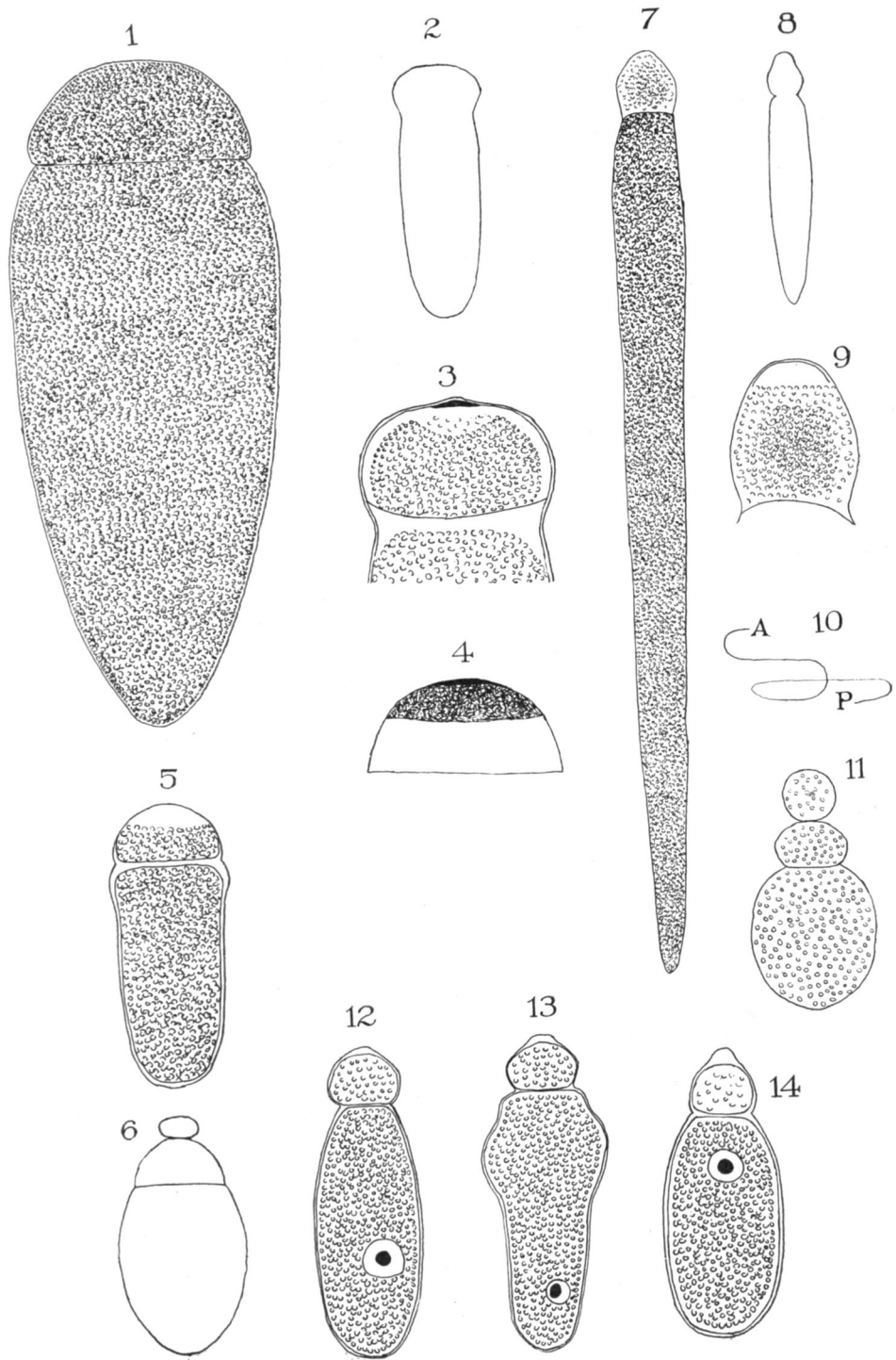
PLATE III, Figs. 29, 30.—*Gregarina xylopi* (p. 47). (Copied from Leidy's MSS.)

Figs. 31-33.—*Asterophora philica* (p. 53). (Copied from Leidy's MSS.)

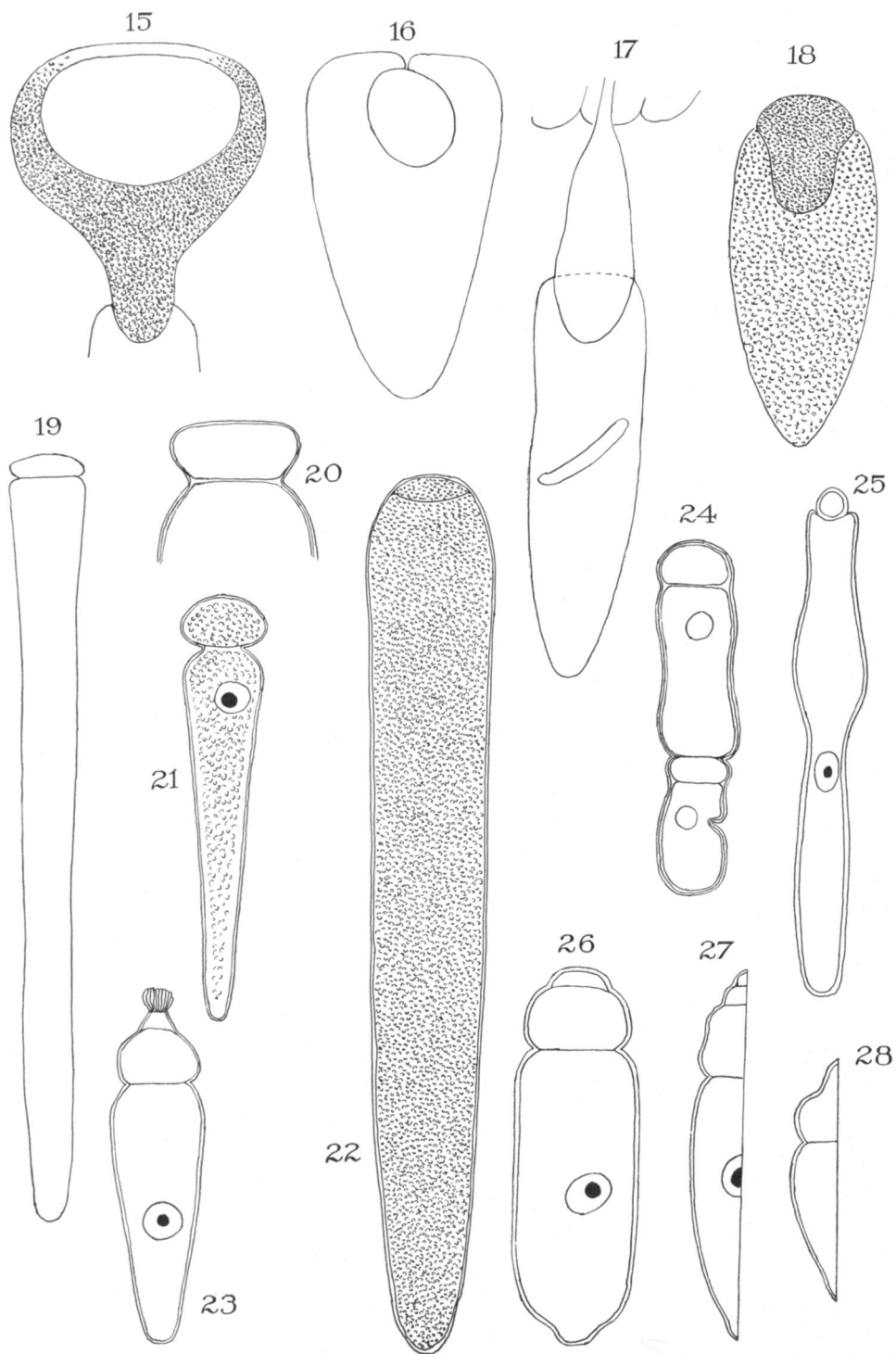
Figs. 34, 35.—*Gregarina achetæabbreviatæ* (p. 45). (Copied from Leidy's MSS.)

Figs. 36-37.—*Hoplorynchus actinotus* (p. 55). Cephalonts. (Copied from Leidy's MSS.)

Fig. 38.—*Euspora lucani* (p. 50). Association. (Copied from Leidy's MSS.)



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